FWL

Force Warfighting Laboratory

"Innovation in the Pacific"

October 2000

Force Warfighting Lab Charter

26 May 1998

1. The Marine Corps has initiated an on-going effort to improve the way Marines will fight and win in the future. The overarching purpose is to ensure the Marine Corps enters the 21st Century as both a relevant and a capable fighting force. Central to this theme is "Focused Innovation" by Marines throughout the Corps. Our best ideas are yet to come, and they will come from the young Marines in the FMF. To this end, the Force Warfighting Lab (FWL) at MARFORPAC is dedicated to two principal efforts: representing the Warfighters within the science and technology community, and facilitating innovation by the Marines, Sailors and civilians of MARFORPAC.

2. The FWL will serve as the focal point for innovation by Marines throughout the Pacific and Central theaters. In this capacity, the FWL will advise the Marine Corps Warfighting Lab on projects of interest which originate within MARFORPAC. This process of "Operational Experimentation" will serve to validate and introduce new ideas to the MCWL and, when applicable, other service battle labs and research centers.

3. The FWL will be organized into an Executive Steering Committee (ESC), chaired by the Deputy Commander and comprised of all staff principals (AC/S G1-G8 and HSD; CO HQSVCBN; CO 1st RADBN; Science Advisor; CNA Representative); and a Working Group (WG), chaired by the Science Advisor and comprised of representatives from each staff section (G1-G8; 1st RADBN; CNA Representative). The Working Group membership will also include "Teams" from each Marine Expeditionary Force. The Hansen Institute will serve as the primary interface to the Marines of III MEF; AC/S G7 will be the principal representative at I MEF.

4. The Working Group will meet monthly to discuss items of interest to MARFORPAC (e.g., Advanced Technology Demonstration [ATD] selections at OPNAV; planning for Dept. of Navy science and technology "Round Tables," etc.). When possible, MEF representatives will provide input by Video Teleconference; otherwise input will be solicited and obtained electronically. The ESC will meet at least once every six months, or when directed by the Deputy Commander.

S. D. Deichman
Prepared by Science Advisor

C. W. Fulford
LtGen C. W. Fulford, Jr., USMC
Approved by Commander, MARFORPAC

Commander's Comments

Lieutenant General Rhodes' article in the Jan 98 issue of the Marine Corps Gazette "Every Marine an Innovator" is right on the mark. In this article, he states that innovation "calls for high-quality, 'out-of-the-box thinking.'" And that "for this important task, it is essential that we engage the brain power of the entire Marine Corps; all hands can and should participate in the process." To do our part, Marine Forces Pacific officially stood up the Force Warfighting Lab (FWL) in May 1998 with the purpose of facilitating innovation and representing the Pacific Marines within the scientific community. The intent is to identify needs and requirements that we can address, help obtain the proper resources (by establishing partnerships with key technical organizations) and get the right people involved for aggressive experimentation and application of technologies.

One key strategy of the FWL is to team with scientists and engineers in the technical community to leverage existing expertise and resources. From the Marine Corps Warfighting Lab (MCWL), we seek overall guidance and aspire to follow their lead and build upon their experiences. The Office of Naval Research (ONR) and the Defense Advanced Research Projects Agency (DARPA) are among the premier technical development organizations in the world. Establishing and maintaining solid partnerships with these organizations is essential to our future and one of the most important tenants of FWL operations. I look forward to continue success as we tackle the great challenges ahead together.

This publication is our first semi-annual report on activities that we are undertaking to promote innovation in the pacific. The topics vary from fuel distribution challenges in support of Operational Maneuver From the Sea (OMFTS) to glider/sail plane concepts as an economical way to complement staff flight hours. The initiatives described in this publication are part of our efforts to continually question the way we do things and to provide rigorous assessments of our tactics, techniques, procedures and systems.

I believe that it is crucial for Pacific Marines to play an increased role in Science and Technology. Science and experimentation is not confined to people in white lab coats. Everyone is capable of innovation and demonstrating their ideas in an objective, quantifiable environment. The FWL will serve as a platform where the entrepreneurial spirit of the Marines, Sailors and civilians can develop, evaluate, and refine their ideas. In addition, it will be the bridge between the Pacific Warfighters and the Technical Community. It will act as a champion of the warfighter in the S&T community and an educator to staff members on the Research Development Test and Evaluation (RDT&E) process. We must understand the environment so that we can better articulate our requirements succinctly and forcibly to help drive the S&T investment strategy in the Department of the Navy. I encourage and welcome all Marines to bring forth ideas that may improve the combat effectiveness of our Corps.

Frank Libutti,
Lieutenant General, USMC

Force Warfighting Lab Initiatives

Platform for Innovation - The Marine Forces Pacific Force Warfighting Lab

BGen John G. Castellaw
Shujie Chang

The United States Marine Corps (USMC) over the years has established itself as among the world's greatest innovators. From the concepts of forcible-entry amphibious assault to close air support/vertical envelopment to now Operational Maneuver From the Sea, the Marine Corps has continually sought better and more efficient ways of improving its warfighting capability. Keeping up with this culture, Marine Forces Pacific (MFP) developed a concept for innovation in the Pacific Theater. This concept was based on establishing a platform where innovative ideas from Marines, Sailors, and civilians can be rigorously assessed, evaluated, tested, and analyzed. This concept of innovation was later established as the Commandant's Warfighting Lab in Quantico, Virginia to "serve as the focal point of warfighting innovations…." (ALMAR 305/95). The Commandant's Warfighting Lab has since been renamed the Marine Corps Warfighting Lab (MCWL). In the meantime, MFP established the Force Commander's Warfighting Lab (FCWL) in 1996 "to engage the operating forces in the process of change, providing 'forward presence' to the (then) Commandant's Warfighting Lab." In 1998, the FCWL was renamed the Force Warfighting Lab (FWL) and a charter was developed and signed by LtGen Carlton Fulford to officially stand up the FWL as we know it today.

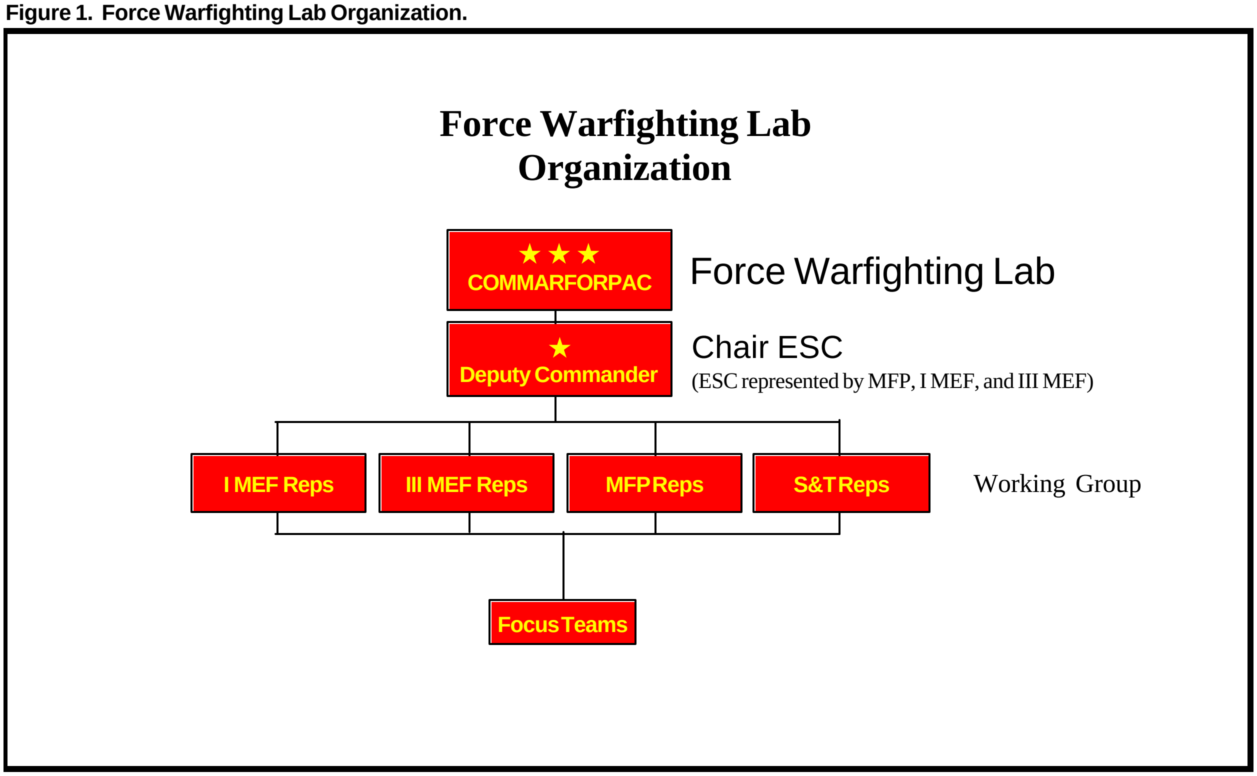
Force Warfighting Lab Operations

The charter states that "the FWL will serve as the focal point for innovation by Marines throughout the Pacific and Central Theaters." To elaborate on this statement, the FWL must be able to receive ideas from Marines, Sailors and civilians, especially at the junior levels, and get the right people involved to work on the initiatives. To succeed, we have to partner with the requirements, scientific and acquisition communities at very early stages of the initiative.

The FWL is organized into an executive steering committee (ESC), working group (WG), and focus teams (please see Figure 1). The ESC is chaired by the MFP Deputy Commander, while the (WG) is chaired by the Science Advisor. The focus teams are where the bulk of the planning and work is being performed. It is made up of experts from the operational and technical communities to execute project objectives.

The WG develops strategies for FWL operations and obtains the resources necessary for execution, while the ESC provides overall guidance. As the FWL is unbudgeted, it is imperative that we form early partnerships with the technical community, such as the MCWL, Office of Naval Research (ONR), Defense Advanced Research Projects Agency (DARPA), and Navy Laboratories and Centers. These organizations make up the technical representation on the focus

Figure 1. Force Warfighting Lab Organization.



teams. It is a solid partnership with each focusing on its strength areas - the technical community provides technical expertise and funding while the operational community articulates true warfighter requirements and provides experimentation platforms in the form of exercises.

Though innovation is not prone to processes, the method of accepting ideas and initiating projects are. Figure 2 shows the process of how initial MFP requirements are developed, technologies identified, and experiments conducted.

The first step is to establish the requirements through the Command Capabilities Issues (CCIs) process. The CCIs are developed by the FWL WG and approved by the ESC. It is a compilation of MFP's 10 most critical requirements that can be solved by technology. This list is then submitted to OPNAV N091 for consolidation into the Naval list of CCIs, which directly influences how ONR allocates their yearly research budget.

Using the CCIs as a baseline, we solicit the technical community for technologies that may directly or partially meet our needs. If a fit is identified (technology with requirement), then we invite the technical sponsors to form a parternship with the FWL. Once agreed, a focus team is stood up comprised of operational and technical experts. The focus team has the job of developing technology prototypes and/or models for experimentation, identifying the appropriate test platforms, developing objectives and metrics, and ensuring that all advanced planning requirements are met. Normally the purpose of the experiment is not to test the soundness of the technology, but rather to test the technology's ability to perform in an uncontrolled environment within our concept of operations. During testing, the focus team, with assistance from the Center for Naval Analysis (CNA) , will perform a rigorous assessment based on our tactics, techniques, procedures, and systems. Results from this experimentation and assessment allow us to better understand and articulate our requirements for handoff to the Marine Corps Combat Development Command (MCCDC) or other acquisition and experimental activities when appropriate.

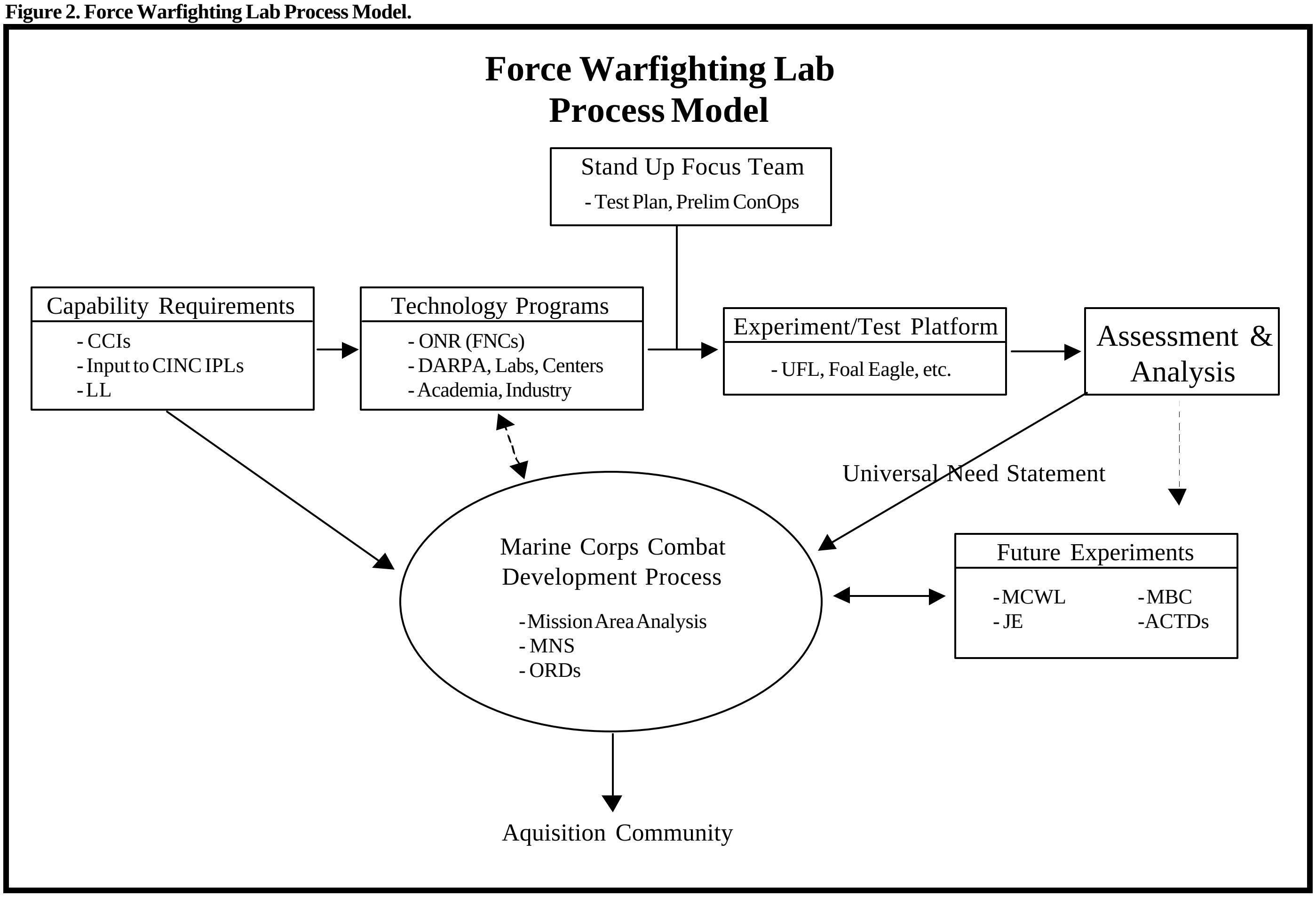
Progress to Date

In just over two years since the signing of the charter, we have made much progress. Our signature project, the ONR sponsored D-Day Mobile Fuel Distribution effort, is currently planned for experimentation with the 31st MEU during Foal Eagle 00. This initiative is being executed by our Expeditionary Bulk Liquids focus team, which includes fuel officers from MFP HQ, I MEF, III MEF and engineers from the Naval Facilities Engineering Services Center (NFESC). Also, this is a joint experiment with CINCPACLFT with support from the 7th Fleet.

Recently during UFL 00, we were able to perform a preliminary test on the DARPA-sponsored English to Korean PowerPoint Language Translator. Results are currently being assessed and should be available in late October.

During 1999, a DARPA-sponsored hydrogen based fuel cell was tested

Figure 2. Force Warfighting Lab Process Model.



during one test exercise and two Combined Arms Exercises (CAX) at Twentynine Palms, California. This system is currently being planned for limited procurement in the near future.

The Naval Asset Visibility program shows promise to track assets from remote locations. CSSG-3 is supporting the testing for this initiative.

Small unit logistic is an Advanced Concept Technology Demonstration (ACTD) program that was started at the 1st FSSG and is finishing up its demonstration to provide logistics command and control at the unit level.

The last initiative discussed in this publication is the flight hour training aid using gliders. It is an idea proposed to use gliders/sailplanes to complement the staff flight hour program.

Conclusion

LtGen Rhodes stated in his January 1998 Marine Corps Gazette article "Every Marine an Innovator" "It is essential that we engage the entire Marine Corps; all hands can and should participate in the process." The FWL is one avenue for which MFP can participate through aggressive experimentation to better articulate our requirements.

Our challenges are many. First, we must formalize the relationship between MFP and the S&T organizations. The FWL can act as a champion of the warfighters in the Science and Technology community and an educator to staff members of the Research Development Test & Evaluation (RDT&E) process. We seek to improve the interaction and coordination between the researchers and the Pacific Marines. Second, we must promote innovation within the subordinate commands. Our best ideas are yet to come and they will likely come from the junior ranks. We must get the word out that there is a platform for innovation and that it will support their ideas. And lastly, we must harness S&T dollars for innovation. It is extremely difficult for an operational command to get new S&T dollars; however, it is much easier to re-direct existing dollars towards our needs. Therefore, it is essential that we partner with the S&T community to articulate our requirements and to ensure that the dollars being spent will truly meet our expectations.

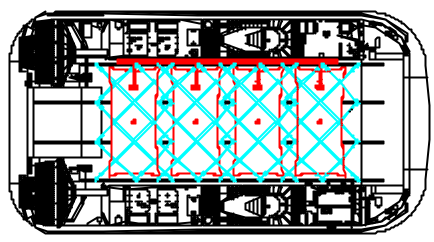
In view of the magnitude and dynamics of the task at hand, the FWL activities are not intended to address all the problems. But rather, it is intended as a platform that will promote innovative thinking, analysis and understanding of our requirements. The challenges mentioned above are difficult, but not insurmountable. However, a dedicated, coordinated and concerted effort on the part of MARFORPAC, it's subordinate commands, and the scientific and acquisition communities will be necessary. It is a full commitment of resources, time, money and manpower, which must be undertaken to achieve the objectives that make the Marine Corps a more capable fighting force. ❖

Sustaining The Warfighter
The Amphibious and Expeditionary Liquids Logistics Challenge

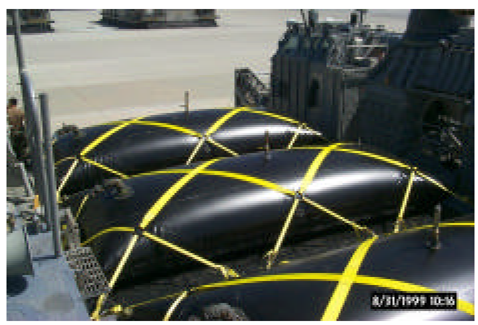
CWO4 Dave Ray, Bulk Liquids Officer, MARFORPAC
CWO4 Mike Giambruno, Bulk Liquids Officer, I MEF
Claude Thomas, Project Engineer, NFESC
CWO4 Robert Collins, Bulk Liquids Officer, 3rd FSSG
Laurence Nixon, Project Leader, NFESC
Mark Miller, Project Engineer, NFESC

We as Marines pride ourselves as students of military history. Any student of military history knows that an army travels on its belly, or in the case of the modern military, on its full fuel tanks! Marine Corps amphibious and expeditionary operations present the commander with unique logistic challenges that are Naval in nature and require unique hardware, doctrine and trained specialist to properly execute.

Deck layout of 15,000-gallon system.



Historically, over 60% of the overall tonnage that U.S. Forces have brought into a contingency theater of operations consist of Class III, bulk petroleum products. For the Navy-Marine Corps Team, amphibious bulk petroleum sustainment has transitioned from the World War II model of 55-gal drums and 5-gal fuel cans to amphibious ships with bulk petroleum discharge systems, floating assault fuel lines, tactical fuel systems and refueling tankers and modules. The modern workhorse for ship to shore petroleum support for the Navy was the Landing Ship Tank (LST) class of amphibious ship. The LST provided the first Logistics Over The Shore (LOTS) sustainment for the landing force via the Navy's Amphibious Assault Bulk Fuel System (AABFS) which consist of 10,000 feet of 6" diameter floating assault hose line. The AABFS interfaces at the high water mark with the USMC Amphibious Assault Fuel System (AAFS) which consist of 20,000 gal capacity fabric fuel tanks, assault fuel hoses, and trailer mounted fuel transfer pumps. This Naval LOTS bulk petroleum distribution system of the LST, AABFS and AAFS has served the Navy-Marine Corps well during the later half of the last century, but things are changing. Due to the emerging doctrine of Operational Maneuver From The Sea (OMFTS) and Ship To Objective Maneuver (STOM) combined with the retirement of the LSTs from the active fleet, the Naval bulk petroleum logistic community must find new hardware, doctrine and procedures to sustain the warfighter. To address this emerging challenge the Marine Forces Pacific, Force Warefighting Lab established a Bulk Liquids Focus Team in Jan of 2000. The Bulk Liquids Focus Team consist of bulk petroleum and water experts from MARFORPAC, I MEF and III MEF teaming with the Naval Facilities Engineering Service Center (NFESC) engineers and scientist. The teams charter is to experiment with emerging science and technology concepts and hardware to meet the Naval bulk petroleum distribution challenge for current and emerging amphibious and expeditionary doctrinal operations.



Photograph of 15,000-gallon system installed on LCAC.

The Team's first project is the D-Day Mobile Fuel Distribution System (DMFDS) initiative. DMFDS is an Office of Naval Research (ONR) sponsored program consisting of three hardware concept demonstration models for distribution of bulk petroleum from amphibious ships to the maneuver force. The DMFDS offers the flexibility to meet both current and emerging OMFTS and STOM doctrine for amphibious and expeditionary operations. Each of the three DMFDS concept demonstrators provides a unique capability, which is described in the following paragraphs.

15,000-Gallon System

The 15,000-gallon D-Day Mobile Fuel Distribution System (15k DMFD) is designed to maximize the LCAC platform to carry fuel ashore during the initial days of an amphibious operation. The 15k DMFD consists of four 3,750-gallon fabric tanks, resulting in a load of approximately 105,000 pounds for the LCAC. It is envisioned that the 15k DMFD would be deployed during the assault echelon after facilities are in place for transferring bulk fuel at the beach, and at which time one or more LCACs can be designated for fuel transport.

3,000-Gallon System

The 3,000-gallon D-Day Mobile Fuel Distribution System (3k DMFD) is designed to be a mobile system (please see figure 3). The 3k DMFD system consists of two collapsible bladders secured to a 1077 flatrack. The assembled and filled system is readily moved by the LVS MK18A1. Three complete systems and an LVS MK

3,000-gallon System loaded on Ground Transportation.

48/18A1 can be transported by LCAC simultaneously to deliver 9,000 gallons of product. The resulting cargo load seen by the LCAC is approximately 60 tons.

400-Gallon System

The EFS 400 is an extension of the D-Day Mobile Fuel Distribution System 400(DMFD 400) development funded by the ONR. The EFS 400 is designed to be a modular system capable of deployment aboard a multitude of ground vehicles and aircraft. The EFS 400 is comprised of individual modules mounted to a unique transport pallet. The individual tank modules break down for reduced storage cube for transport aboard amphibious shipping, yet assemble to provide a Department of Transportation (DOT) certifiable 400-gallon fuel tank. Ten tanks can be mounted on the transport pallet and provide 4,000 gallons of bulk fuel for transport aboard the Logistics Vehicle System (LVS). All ten tanks can be filled or drained simultaneously through the 4" camlock fittings located on the transport pallet making the EFS 400 operate just like any other 4,000 gallon bulk transport container. The modular configuration eliminates fluid slosh to improve transportation stability much like extensive baffling in larger single tanks.

Autonomous Marine Booster Pump

400-Gallon System

All three DMFDS concept demonstrators were tested with water in lieu of fuel at Camp Pendleton Calif. in May 2000 during the RIMPAC East 2000 amphibious exercise. The 400-gallon EFS was demonstrated with diesel fuel during a Combined Arms Exercise (CAX) at Twentynine Palms in July of 2000. During both demonstrations, refinements were identified for the concept hardware from users. Navy and Marine personnel gave all three systems high marks for flexibility and utility during the demonstrations. The next scheduled demonstration is during exercise Foal Eagle in the Republic of Korea during the fall of 2000. This demonstration will be conducted from the amphibious ships of the 31st MEU and will simulate OMFTS and STOM environments by distributing JP-5 in all three systems from 25 miles offshore to USMC tactical fuel systems and tactical vehicles ashore. The Foal Eagle demonstration will not only be an evaluation of the DMFDS concept demonstrators, but of the current Naval bulk liquids distribution system (amphibious ships and tactical fuel systems) to provide fuel distribution in an OMFTS/STOM environment.

Amphibious Bulk Liquids Transfer System

The next project the Bulk Liquids Team is proposing to coordinate is the demonstration of ONR's Prototype Autonomous Marine Booster Pump (AMBP) with the newly fielded Amphibious Bulk Liquids Transfer System (ABLTS). The ABLTS will be fielded in mid FY01 to replace the Navy's aging AABFS floating fuel line. The ABLTS will consist of lighter weight floating fuel line with swivel connectors to enhance ease of deployment/retrograde and a reduced embarkation footprint in comparison to the AABFS. The AMBP prototype is designed to be used with two or more ABLTS in order to extend their ship to shore distribution distance beyond the 10,000 feet of a single ABLTS and maintain the required flow rate of 600 GPM. The ABLTS/AMBP combination provides the Navy-Marine team with the capability to provide bulk petroleum sustainment of an MEB-MEF sized MAGTF ashore via a LOTS operation. The ABLTS/AMBP combination provides the next higher level of fuel support beyond the initial amphibious support provided by the DMFDS for sustained operations ashore of an MEB-MEF sized MAGTF.

The DMFDS 3k and 400-gal systems can be used to move fuel inland as traditional mobile tactical distribution assets once the MAGTFs daily fuel requirements ashore have increased to a level requiring a ABLTS/AMBP LOTS. The additional standoff distance that the AMBP provides for Naval bulk petroleum distribution is vital to ensuring the Navy's ability to establish LOTS operations from existing and future amphibious platforms and the challenges of shallow water littorals the Navy- Marine Corps Team is facing in numerous theaters of operations. MARFORPAC will be teaming with CINCPACFLT to explore the demonstration of the ABLTS/AMBP concept during a FY01 Pacific regional exercise.

The first year for the Bulk Liquids Focus Team has been aggressive and challenging. The teaming of the warfighter with the scientific and engineering community has developed a dynamic catalyst for change and demonstration of emerging technology and concepts for the warfighter to touch, feel and shape. The amphibious and expeditionary bulk liquids challenge will open the door to other technologies and concepts for overall emerging logistic technologies to better support amphibious and expeditionary MAGTF operations from the sea and ashore. ❖

Machine-assisted English/Korean Translation at Ulchi Focus Lens (UFL) 2000

GySgt Roosevelt Adrianza, MARFORPAC
Sgt Monica Vega, MARFORPAC
Dr. Young-Suk Lee, MIT Lincoln Laboratory
Dr. Clifford Weinstein, MIT Lincoln Laboratory
Dr. Gary Strong, Defense Advanced Research Projects Agency

The Marine Forces Pacific (MFP) Force Warfighting Lab (FWL) in conjunction with the G-2/Counterintelligence Humint Branch has established a language translation initiative partnership with the Defense Advanced Research Projects Agency (DARPA) and Massachusetts Institute of Technology (MIT)/Lincoln Laboratory. The purpose of this initiative was two-fold: A). To provide COMMARFORPAC and his Staff, a translation capability during exercise UFL-00 that would communicate and express to our Republic of Korea (ROK) Marine Corps counterparts our intent through English-to-Korean translations in PowerPoint presentations and text translations (as required). B). To further develop, in the near future, a capable language translation system/suite to be deployed during contingencies to provide Counter Intelligence/Human Intelligence (CI/HUMINT) assets for supporting foreign language debriefs (Enemy Prison of Wars or detained personnel) and translation to collect and report intelligence information. This capability would allow us to break the language barrier at the fast pace operational level to fulfill the commander's mission requirements.

In a collaborative effort, a machine-assisted English/Korean translation system developed by MIT/Lincoln Laboratory was demonstrated and tested at the Ulchi Focus Lens 2000 Exercise (UFL 2000) in August, 2000. The translation system, called CCLINC (Common Coalition Language System at Lincoln Laboratory), was used to translate Powerpoint briefings from English to Korean and to enhance the efficiency of producing the bilingual briefings which are needed to communicate key information, status, and plans to both US and ROK personnel. An important feature of this effort was that the CCLINC system was brought to UFL and operated directly by Marine personnel, who were able to make changes in the field to the translation dictionaries to tailor the system to special UFL terminology. Training of Marine personnel to operate and modify CCLINC was accomplished during a 5-day visit by one Marine Sergeant to Lincoln Laboratory.

Background

The U.S. military must operate worldwide in a variety of international environments where many different languages are used. There is a critical need for translation, and there is a shortage of translators, particularly of translators who can correctly interpret military terminology. To address these needs, DARPA has a number of ongoing R&D efforts in machine translation including DARPA one-way speech translation system and DARPA phrase translator (Marine Acoustics). One coalition environment where the need is particularly strong is in the Republic of Korea (ROK) where, although U.S. and ROK military personnel have been working together for many years, the language barrier still significantly reduces the speed and effectiveness of coalition command and control. A DARPA-sponsored effort at MIT Lincoln Laboratory has been addressing English/Korean translation for the last several years (Weinstein et al. 1997), and has resulted in successful demonstration of machine-assisted translation of CINC briefings at RSO&I 99 (April, 1999) and at other exercises.

Based on this experience, and on interactions among the FWL, DARPA, and Lincoln Laboratory, an initiative was undertaken to demonstrate and test the Lincoln CCLINC translation system at UFL 2000. In previous exercises involving CCLINC, the demonstrations and tests had been carried out with on-site involvement of the Lincoln developer team. For UFL 2000, it was decided that CCLINC would be operated only by Marine personnel, without the presence of the technology developers. The purpose of this approach was to gain experience in, and establish feasibility of, effective technology transfer to military users.

The CCLINC system is being developed to encompass a broad set of translation capabilities, including two-way translation of both text and speech and translingual information access (i.e., translingual information detection, extraction and summarization). Also, the CCLINC technology utilizes an interlingua-based approach to machine translation that is readily adaptable to multiple languages. However, for the UFL 2000 exercise, the use of CCLINC was restricted to English-to-Korean translation of briefing materials. This is the CCLINC capability which has undergone the most development, and is closest to being ready for transfer to the user community.

CCLINC Translation System Structure

The CCLINC system architecture (Figure 1) consists of a modular, multilingual structure including language Understanding and Generation modules in English and Korean. The core language understanding and generation systems were originally developed at the MIT Laboratory for Computer Science for applications in human-computer interaction. The CCLINC project has been the first to adapt this technology to language translation and to the Korean language specifically. The Understanding module of CCLINC converts each input into a language-neutral, interlingual meaning representation called a Semantic Frame.

The system provides feedback to the originator on its understanding of each input by forming a paraphrase in the originator's language. For example, when an English sentence is entered into the system, the sentence is transformed into a Semantic Frame by the English Understanding module. The English Generation module then produces a paraphrase of what the system understood, which can be verified by the originator. The interlingua approach expedites the extension of the system to multiple languages. For example, adding Japanese to the English/Korean system would require Japanese Understanding and Generation modules, but the English and Korean modules would not change. A two-way connection is shown between the translation system and a command, control, communications, computing, and intelligence (C4I) system. Research is currently ongoing to enable translingual information access to multilingual material via this type of connection.

CCLINC System Training and Automated Tools for Updating Lexicons and Grammars

The two core modules of CCLINC, Understanding and Generation, each require lexicons and grammars for the domain of interest. A substantial part of the CCLINC effort has been the development of lexicons and grammars for the CINC briefing domain. The development of high-performance lexicons and grammars depends in turn on the availability and application of a substantial amount of training data, consisting in this case of examples of CINC briefings. In preparation for exercises in Korea, USFK personnel had provided a considerable number of CINC briefings, many in both English and Korean. These data were critical in developing the system. During the various interactions with the users, it also became clear that a mechanism was needed to facilitate user updating and modification of the system lexicon; e.g., to include new terms specific to a particular mission area. Such a capability was developed prior to the June 1998 exercise held at USFK, and was demonstrated during that visit, and the subsequent visits during Foal Eagle 1998 and RSO&I 99. The update capability includes a convenient user interface to update the vocabulary in system lexicons, and an automated capability to intergrate these words into the system grammar.

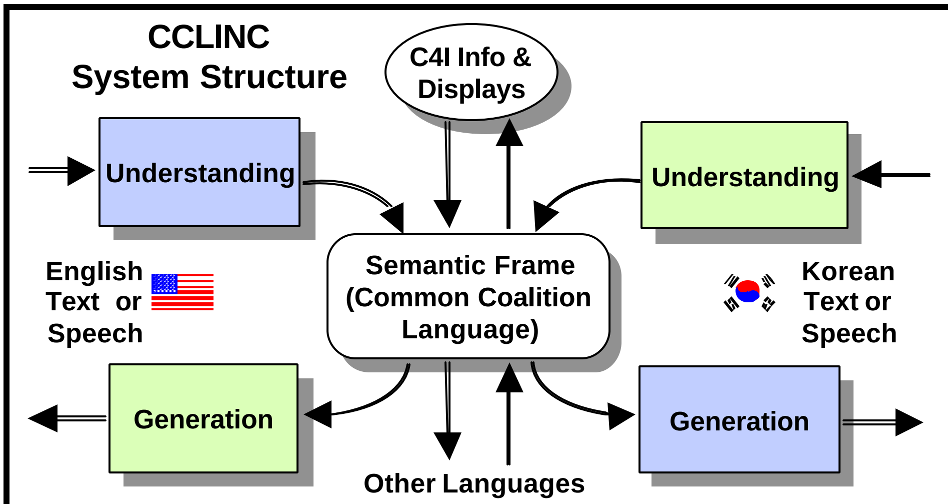


Figure 1. CCLINC Translingual Information System Structure.

User Training and Translation of UFL Briefings

In preparation for the UFL exercise, Marine Sgt. Monica Vega visited MIT Lincoln Laboratory for the period July 24-28, 2000. Sgt. Vega was provided with a CCLINC system, operating on a Pentium laptop, and with documentation on how to set up and run CCLINC, and on how to modify the translation vocabulary in order to include new terminology which would be needed for UFL. Dr. Young-Suk Lee of Lincoln Laboratory provided direct CCLINC training for Sgt. Vega during this week. In addition to learning CCLINC, Sgt. Vega was able to enhance the system vocabulary during the week at Lincoln by *utilizing the tools for automated updating of lexicons and grammars*, so that good translation could be produced of UFL

Figure 2. Sample UFL slides in English (original) and Korean (translated by CCLINC).

briefing material which Sgt. Vega had brought with her. Figure 2 shows side-by-side examples of two sample UFL slides as they were translated by CCLINC, after Sgt. Vega had made a number of additions to the system vocabulary. After one week at Lincoln, Sgt. Vega had become quite proficient in CCLINC operation, and was ready to bring the system with her to UFL.

CCLINC Experience at UFL 2000

Sgt. Vega brought the CCLINC system to UFL 2000, and was able to bring it into operation successfully at Palan, where she was located. CCLINC worked well on English-to-Korean translation of the short, bulletized sentences which are typical of PowerPoint briefings, and Sgt. Vega was able to modify the CCLINC vocabulary to add new terminology which occurred in the UFL material. This was a substantial success in technology transfer, since it achieved the goal of this particular technology transfer effort. It is especially significant that Sgt. Vega was able to operate and modify CCLINC without the assistance of developer personnel. Many of the users were interested in translation capabilities beyond what was possible with the current version of CCLINC. For example, there was interest in translating documents which contained complex sentences, for which, although some work has been done, the translation capability of CCLINC has not yet been fully developed. This indicates that there remains a broad need for machine-assisted translation for the US/ROK coalition, and that more development and technology transfer efforts are needed.

Future Efforts

We believe that the three-party initiative among DARPA, MIT Lincoln Laboratory, and Marine Forces Pacific to transfer the CCLINC translingual information technology to Marine Forces Pacific is off to a great start. After 5-day user training at MIT Lincoln Laboratory, the English-to-Korean text translation system was successfully deployed during the UFL 2000 US/ROK Joint Coalition Exercise by a U.S. Marine, Sgt. Monica Vega. This indicates the high quality, maturity and user friendliness of the CCLINC translation system, and its

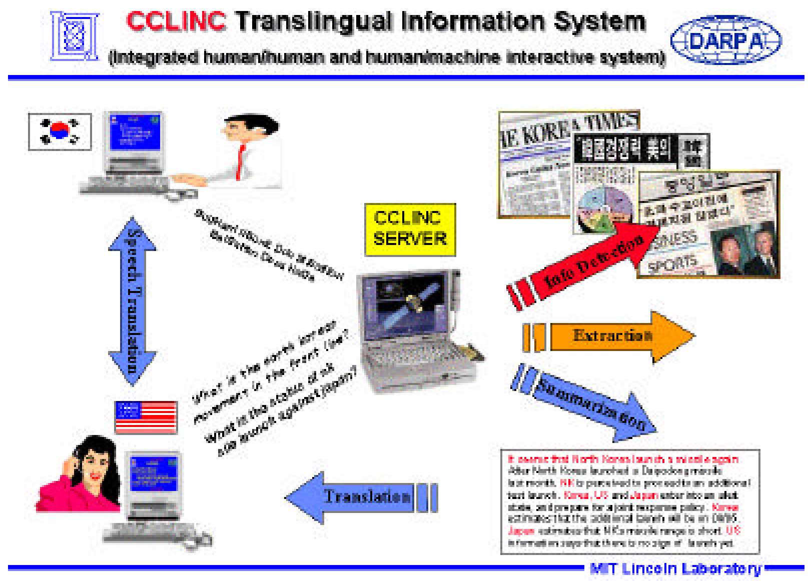


Figure 3. Integrated CCLINC Translingual Information System.

readiness for enhancing the effectiveness of human translators in coalition military operations. In addition to the English-to-Korean text translation system, CCLINC translingual information system includes many other component technologies which MIT Lincoln Laboratory has been developing under DARPA sponsorship in conjunction with TIDES (Translingual Information Detection, Extraction, and Summarization) and Communicator programs, as shown in Figure 3: (1) English/Korean 2-way speech-to-speech translation system which enables US and ROK coalition partners to communicate in real time for urgent information exchange, (2) Korean-to-English document translation system which translates Korean newspaper articles, and enables the user to gather the core information of fast-breaking news on the internet, (3) translingual information detection, extraction and summarization system which gathers multilingual information and provides the English summary to the user, given the user query in English. The ultimate goal of developing high quality translingual information systems is to improve speed and precision in coalition collaboration via automated translation and translingual access to C4I information, and thereby providing force multiplier to the US military in the Information Age.

Finally, efficient communications among the users, system developers/researchers, and program sponsors are essential for successful technology transfer. Especially, bi-directional collaboration between the users and the system developers in terms of providing training data, user training and technical support has proven to be most critical. The recent collaboration between Marine Forces Pacific and MIT Lincoln Laboratory to deploy the CCLINC translation system in the UFL 2000 Exercise clearly shows that the needed collaboration can take place within a very short period time when needed, and certainly provides a major first step for continuing, successful CCLINC technology transfer to the US Marines.

Conclusions

Even though the Language Translation Initiative may answer the immediate call to closing the language barrier with our combined counterparts, the need to closely tie our intelligence collector assets (CI/HUMINT) into the equation remains as the primary task. The ability to brief PowerPoint presentations and translate text documents at the component headquarters level will continue to be important throughout the advancement of MARFORPAC's language requirements. However, answering the commanders PIR's/CCIR's/EEI's on the battleground, will be the primary objective. For this reason, MARFORPAC will continue work with the two-fold objective of the current MIT/Lincoln Laboratory language initiative. Operational tempo, shortfalls in the Counterintelligence/Humint MOS, an imbalance in languages and the lack of a Marine Corps-wide program that monitors and adjusts for language shortfalls and requirements for secondary language trained personnel have resulted in major gaps when contingencies arise.

While 8611's (Non-intelligence linguists) should assist in filling these gaps, the system to identify language capable personnel is based on proactive input, which often does not occur. Regular input from the Marine Forces in identifying language needs and requirements is critical in maintaining a balanced cadre of languages "on-the-shelf" to support operational requirements. In addition, greater emphasis needs to be placed on secondary language training, for those who already possess one language and on the secondary languages themselves. In essence, a well developed translator suite with multiple language capability, along with appropriately trained and equipped CI/HUMINT Teams, will provide the Marine Corps future a "Bang for Buck" satisfying component commander intelligence collections requirements from the company to the headquarters level. ❖

References

Automated English/Korean Translation for Enhanced Coalition Communications, C. J. Weinstein, Y. S. Lee, S. Seneff, D. Tummala, B. Carlson, J. Lynch, J. T. Hwang, and L. Kukolich, in the Lincoln Laboratory Journal, vol. 10, number 1, 1997, pp. 35-60

The Small Unit Logistics (SUL) Advanced Concept Technology Demonstration (ACTD)

Modernization for the Logistics Tactical Commander

Col Jeff Grelson , CO BSSG1
Lynn Torres, Program Manager, ONR

Abstract

As the Marine Corps positions itself for combat in the new millennium, warfighting communities are refining command and control (C2) capabilities to make it possible to have the right resources in the right place, in the right quantity, at the right time. Operational Maneuver from the Sea (OMFTS) has brought with it the recognition that fluid movement, user-common information and total asset visibility (TAV) are paramount if this warfighting credo is to succeed.

The lifeblood of OMFTS will be the logistics pipeline, the flow of resources and services to the warfighter. Logisticians currently manage this flow manually, much as they have been doing since the inception of amphibious operations. Voice radio is still the primary means of communications, with hand carried information the primary reliable back-up. TAV does not exist except insofar as one person can communicate with all of the operational participants – again, manually. The staff planning and decision-making processes for commanders are still dependent on face-to-face communications and meetings, grease pencils, and flip charts. However, with new technologies appearing rapidly, the ability to exchange and pass electronic files, incorporate decision support tools and automate many of the more traditional and manually time consuming logistics functions, can now be performed and exchanged utilizing the extensive military worldwide data services currently available (NIPRNET/SIPRNET). These services provide the infrastructure for the transport of both unclassified and classified data, and can make the possibility of an automated CSS C2 system a reality.

Introduction

Since WWII and continuing through Desert Shield/Storm, the relied-upon logistics paradigm was to sacrifice efficiency for effectiveness. Logisticians relied on the principle of logistics mass to ensure that operational forces had sufficient services and supplies. This often resulted in a significant over statement of requirements.

With the advent of the OMFTS and Ship to Objective Maneuver (STOM) concepts as well as the smaller forces resulting from the end of the Cold War, the Marine Corps can no longer abide logistics inefficiencies. For example, the landing in Sicily in 1943 consisted of over 3000 ships. The battle of Okinawa, in 1945, had over 1500 ships. Ship assets, both combatant and support (gray bottom and commercial), no longer exist in the quantities that could be counted upon during World War II and Desert Storm. Today's vessels, though fewer in number, have greatly improved capability, but each is also much more mission critical than in the past.

Expanding and changing mission profiles for the military, as indicated in the conceptual framework of Joint Vision 2010, requires that logisticians provide rapid crisis response, track and shift assets in route, and deliver tailored logistics packages where and when needed. Although fundamentally this has always been a responsibility of the logistics community, only recently has technology existed that will allow sweeping changes in the way logistics can be executed.

SUL ACTD Origins

Deputy Under Secretary of Defense for Advanced Technologies (DUSD (AT)) approved the Small Unit Logistics ACTD as a FY99 new start on 11 December 1998. The SUL ACTD is an outgrowth of the efforts of the Marine Corps Warfighting Laboratory's (MCWL) Hunter and Urban Warrior Advanced Warfighting Experiments (AWEs). 1st Force Service Support Group (FSSG) continued to experiment with novel initiatives after completion of the Hunter Warrior. The 1st FSSG submitted to DUSD (AT) a request for an ACTD. The Marine Corps Systems Command was appointed the Executive Agent for the SUL ACTD. Commander in Chief, US Pacific Command (CINCUSPACOM) is the Operational Sponsor with 1st FSSG assigned as the Operational Manager. This is a jointly sponsored ACTD with participation from the U.S. Army. The effort is funded, managed, and executed by the Office of Naval Research.

Program Objectives

The Purpose of the SUL ACTD is to develop an interoperable tactical logistics command and control system that uses existing and emerging technologies to improve combat service support effectiveness and efficiency. SUL will demonstrate a "proof-of-concept" to improve logistics command and coordination through the application and integration of web based automated information technologies. Specific demonstration objectives include the following:

- Improve tactical/small unit logistics,
- Improve CSS effectiveness and efficiency to reduce logistics footprint,
- Enable the tactical logistician to better support his forces,
- Enhance CSS decision-making in support of deployed tactical units.

The SUL ACTD Vision

The SUL ACTD vision is to bring together, through a single portal, the data from stovepipe legacy logistics and operational systems using inexpensive and flexible web technologies (Figure 1, next page). This single portal becomes the means of extracting, consolidating, transforming, aggregating and presenting information into a format usable for command and coordination. Further, SUL will provide decision support tools to aide the CSS commander and his staff in logistics decision-making . The end result should be a significant reduction in

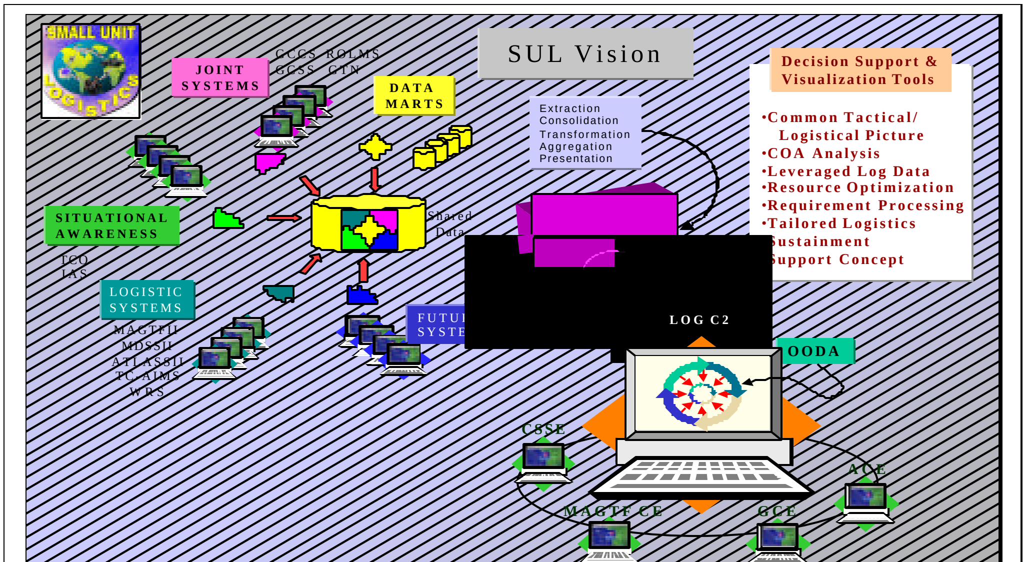


Figure 1. SUL ACTD

the observe, orient, decide, and act (OODA) loop.

Not only will the SUL ACTD significantly improve internal CSSOC operations, it will also provide a logistics picture to the MAGTF Commander and his G-4. Further, it will provide a portal for the Ground Combat Element (GCE) and the Air Combat Element (ACE) to track and post their logistical requirements. Specifically the SUL ACTD wants to demonstrate:

- Better visibility to more timely, accurate Logistics information
- Determine supportability of different courses of action
- Better decisions on how to optimize CSS resources within the theater of operations
- Create measures of effectiveness for CSS Operations
- Focused functionality, field testable proof of concept in six months that demonstrates military value
- Pilot application ready in one year
- Ready for Milestone III decision after final demonstration

Operational Impacts of SUL ACTD are both quantitative and qualitative. Quantitatively, the outcome of the ACTD should produce a reduction in the OODA loop cycle times (i.e., repair or product order cycles, services response cycles, etc.) and right sizing of the logistics footprint. Qualitatively, it will allow the CSS Element staff to focus efforts on decision making vice gathering of data. It will enable the commander to make better, more informed decisions empowering MAGTF planners to support and sustain tactical maneuver by providing efficient, effective, and timely continuity of CSS.

Background

The CSS C2 system will be a totally new capability that will enhance the MAGTFs ability to prosecute war. However, the CSS C2 system is dependent on the data resident in existing legacy systems for further manipulation and tailoring in the context of command and control. Therefore, in order to realize the full potential of the CSS system, it must pull data from numerous other USMC and Joint systems/ applications (i.e., ATLASS, ROLMS, C2PC, MAGTF II, MDSS, GCCS, JTAV, GTN, etc.). The CSS C2 system, working within the larger context of a shared data environment will provide the Marine Corps with a flexible, scaleable and robust logistics C2 system to enable more precise and responsive logistics support at the tactical level. The CSS C2 system's unique capabilities in the future will include:

- The ability to conduct/perform tailored logistics mission analysis.
- The ability to develop various logistics Courses of Action (COA).
- The ability to automate the development and issuance of logistics orders
- The ability to monitor the execution and rapidly respond to changing tactical situations.
- The ability to overlay a logistics picture onto the tactical picture provided by the legacy C2PC system.
- The ability to submit automated re-supply and support requests.
- The ability to rapidly assess, reconstruct and reconstitute the force.

Rules of Employment

The CSS C2 system will be a tactical level system. The system information is dependent on the accuracy of the data downloaded from the legacy systems or boss files used throughout the Marine Corps. The system's capabilities will be accessed and utilized in a random fashion depending on the needs of the user. The following rules of employment provide a very preliminary perspective, regarding the CSS C2 system employment.

Ship to Objective Maneuver (STOM)

Under STOM, the CSS C2 system will provide the essential CSS C2 for the force. The CSS C2 system will provide the basis for conducting the logistics portion of the Marine Corps Planning Process (MCPP), specifically, CSS mission planning and COA development. During the execution phase of STOM, the CSS C2 system will be the principle system to monitor CSS readiness, receive CSS support request (Rapid Request Tracking), coordinate ground equipment maintenance actions and dispatch contact teams, engineer support, etc.

Sustained Operations Ashore (SOA)

SOA will require the CSS C2 system to perform traditional MCPP functions in accordance with the operational phases designated by the MAGTF Commander. Once ashore, the CSS C2 system will provide the primary means to manage, execute and monitor CSS and logistics tasks for the duration of the operation. The CSS system will receive requests from the maneuver forces, process and assign action, prioritize the action, and process transactional items for issue. Additionally, the CSS C2 system will allow the CSS Commander to anticipate demands (based on consumption and expenditures), thereby maintaining a smooth flow of re-supply into theater. The CSS Commander will also be able to identify issues or trends and other critical indicators that point to MAGTF readiness.

Sea Based Logistics (SBL)

Although SBL is more appropriately a military condition than a mission, it is included here because it is fundamental to the OMFTS concept. SBL will require the

CSS Commander to monitor and support the maneuver forces through a number of task organized Mobile CSSD (MCSSD) and/or directly from the sea base. This will require greater dependence on air assets and the coordination of ship landing platforms and location of horizontally stowed supplies across the task force.

Amphibious Assault

During traditional amphibious assaults, the CSS C2 system will be employed to support logistics personnel in their mission planning and COA development. Once in the execution phase of an amphibious assault, the CSS C2 system will be employed throughout the landing force and in the Tactical Logistical Center (TACLOG). Report consolidation, consumption levels, safety levels will all be accessible via the CSS C2 system. A log picture will be available within the CSS C2 system as an extension of TCO/C2PC.

Maritime Prepositioned Force (MFP)

During MPF operations, the CSS C2 system will be activated when units transition from movement formations to tactical formations. Once units depart the arrival and assembly areas and proceed to occupy tactical positions, the CSS C2 system will be the primary means to communicate, execute and monitor CSS requests. All MPF information should be accessible via CSS C2 system as the Port Operations Group (POG) maintains an accurate record of unit's arrival, equipment offloaded and issues of supplies and equipment.

Operations Other Than War (OOTW)

OOTW includes all those military missions not covered above, and yet are short of war. The CSS C2 system will provide the logistics officers with the automated capability to conduct mission planning, COA development, orders development and execution monitoring. The CSS C2 system's inherent flexibility will allow the Commander insight into his resources, thereby permitting unprecedented response times and the capability to react to rapidly changing situations. The CSS C2 system will augment the Civilian/Military Operations Center (either afloat or ashore) with the capability to estimate sustainment for the support of refugee operations, route planning, etc.

Garrison Operations

The CSS C2 system can be employed in garrison for everyday operations. Due to the garrison environment, many of the CSS C2 functions will not be needed. However, everyday visibility of equipment, supply and personnel readiness can be tracked via the CSS C2 system. The CSS C2 system can also be utilized as a training aid for staff development. Employing the CSS C2 system in both garrison and while deployed helps to eliminate the distinction between these two operating environments and contributes to a more efficient and effective operating organization.

Concept of Employment

The system will be employed like any other tactical C2 system to provide the Commander/principle staff officers with the means to plan and execute his logistics/CSS missions and tasks more efficiently. For instance, the CSS C2 system could be employed in the MEF COC not unlike the Fire Support Coordination Center is employed/collocated in the COC to provide the Commander with the means to coordinate and de-conflict fire support efforts among his various units and resources. The CSS system therefore will provide the Commander with an equivalent logistics support coordination center to assist in managing all his combat service support needs.

Combat Service Support Operations Center (CSSOC)

The CSS C2 system is designed to be employed within the CSSOC as the CSSD Commanders principle tool for logistics planning and execution. The CSS C2 system can be configured to support the establishment of a future plans cell, current operations cell, rear area security cell, etc. The primary consideration in the configuration of the CSSOC is the issue of security classification/access to information. If the CSS C2 system is configured on the SIPRNET, then properly cleared Marines are the only ones authorized to access the CSS C2 system.

Battalion/Squadron/Regimental/Group Operations Center

The CSS C2 system is envisioned to be principally employed by the S-4 Officer as his primary means to compute, consolidate, request and track combat service support. The S-4 Officer, representing the Commander, will be capable of monitoring his assigned units and attachments, correlating maneuver requirements with readiness levels, and ensuring unit missions and tasks are thoroughly planned out and supported. He will also use the system to request services and supplies from the CSSOC as well as receive any logistics specific instructions.

MAGTF Command Element

At this level the principle user will be the G-4 of the MAGTF. He will make particular use of the mission planning and course of action functionality of the CSS C2 system. Employing the computational tools provided in the system will allow the G-4 to determine sustainment requirements, recommend safety levels, and review alternative sources of supply. The G-4 will work closely with the CSSOC to establish priorities, allocate resources, and source low-density items of supply. The G-4 will be able to monitor consumption and expenditure levels, track equipment readiness and project status (i.e., construction projects) and correlate logistics issues with the Commander's operational/tactical objectives.

Mission Analysis

The CSS C2 system is tailored to support logistics/CSS mission analysis, focusing on sustainment planning, distribution, maintenance, and those Commander's Critical Information Requirements (CCIR) that will support CSS execution.

Course Of Action (COA) Development

Utilizing the product(s) of mission analysis, the planners use the mission statement (higher headquarters commander's intent), commander's intent, and commander's planning guidance to develop the COA(s). Each COA is examined to ensure that it is suitable, feasible, acceptable, distinguishable, and complete with respect to the current situation, the mission and the commander's intent. Inherent in this mission essential function is COA Wargaming and COA Comparison and Decision. COA wargaming and comparison are normally broken out as separate steps under MCWP 5-1, Marine Corps Planning Process; however, the CSS C2 system will contain the capability to integrate these functions.

Execution

Under the traditional Marine Corps Planning Process this step is referred to as Transition. This is primarily concerned with the orderly handover of a plan or order as it is passed to those tasked with the execution of the operation. It provides those who are responsible for the execution of the plan or order with the situational awareness and rationale for key decisions necessary to ensure there is a coherent shift from planning to execution.

Reconstitution

The ability to reconstitute the force will be significantly enhanced with the CSS C2 system. Accurate readiness pictures, inventory levels, safety factors and computational models will allow the MAGTF to precisely determine their posture and determine/direct the requisition of required materials and supplies to reconstitute the force. Reconstitution attainment levels can be precisely calculated and/or estimated based on CSS C2 system interfaces with GTN, JTAV, and GCSS-M, thereby, allowing the MAGTF Commander to rapidly bring his force back up to a full ready status.

Conclusion

The SUL ACTD is a long-awaited first step towards modernizing tactical logistics practices in the Marine Corps. It will begin to provide the modern logistics warfare officer with the tools needed to conduct efficient, targeted, flexible logistics support to Marine forces. ❖

Where Are We Going In Asset Management?

Ramon Flores, Project Engineer, NFESC
Nick Olah, Program Manager, NFESC

Introduction

The need for a reliable logistics management system has long been the bane of the warfaring community – from the days of Julius Caesar when supplies were foraged from the immediate neighborhood to Operation Desert Storm where complex machinery, foodstuffs and health services were funneled from the States. In the first six-months of Desert Storm the amount of supplies shipped to Saudi Arabia was comparable to the first six months buildup in Vietnam. In the next century, logistics will have to support the emphasis of increasing the speed and tempo of operations. The hardware for tracking will need to be smaller, less expensive but more rugged and reliable so that it can be attached to anything that moves – and be readable by any authorized user from portable computers, desktop systems and from world wide web interfaces.

Architecture

In 1989 The Naval Facilities Engineering Services Center (NFESC) working with the Office of Naval Research (ONR) and the Amphibious Warfare Technology Directorate at the Marine Corps Systems Command, developed a logistics management architecture using radio frequency identification (RFID) technologies. The architecture was based on four levels of visibility as described below.

1. *In-The-Box Visibility (IBV).* By using automatic identification technologies (AIT) devices, such as a family of radio frequency tags, asset information can be automatically updated by a manifest tag as they enter or leave a container. In this manner, the tagged assets themselves are the data source. The desired data can be transmitted from the tag database to the main database quickly, accurately, and remotely without the manpower requirements associated with existing procedures.

2. *In-Facility Visibility (IFV).* Using radio frequency tags, readers, wireless links, and a PC based system, assets can be tracked within a warehouse or facility. Information transfer is accomplished quickly and accurately, via radio frequency signals and local area network connections.

3. *Wide Area Tracking.* This capability allows for real-time tracking of assets within the Battlefield Area (hundreds's of square miles). This is accomplished by designing fixed reader systems and/or using surrogate satellite system readers, such as a remotely operated vehicles, to cover the operational battlefield. The tags on the container can communicate with the interrogators to relay the required information to the desired command levels. Data collected from remote readers is aggregated at a central server that is web-enabled for world wide data dissemination.

4. *In-Transit Visibility (ITV).* By introducing tags that communicate with satellites, assets can be tracked (near real time) worldwide. This technology will provide two-way communication from the tag to the satellite and downloaded to web based systems. This is a key enabler for asset visibility when tags are out of range of the readers.

To effectively provide a responsive supply system, these four levels of visibility must be achieved and implemented. The architecture also addressed the necessity of equiping the operational equipment and principle end items with on-board diagnostics and sensors to supply information regarding the physical condition of an item as well as the physical location.

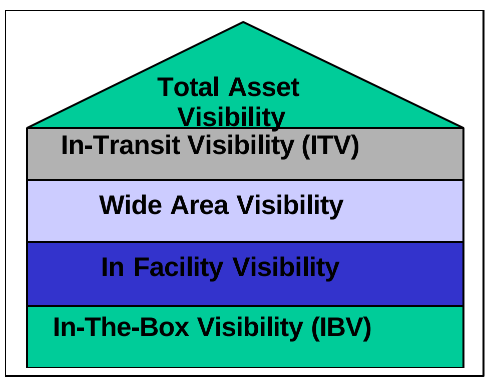


Figure 1: Asset Visibility Architecture. In–the-Box, In Facility, Wide Area and In Transit Visibility.

The Beginning

The first generation of RFID hardware addressed in the architecture was developed by SAVI technology under a Small Business Innovative Research(SBIR) project. This effort was coordinated with the offices of the Naval Supply System Command and the Office of Naval Research. The basic idea consists of developing RFID hardware to track containers and principal end items that are tagged with radio-frequency (RF) emitting tags. The RFID tags contain a cargo manifest of the container items that can be read by several different types of interrogation systems ranging from palm sized hand held interrogators(HHI) to fixed interrogators to satellite messaging. The success of the initial SBIR effort has lead to the development of advanced RFID technologies for asset tracking that has benefited all services in the DoD. It also provided the initial baseline technology that allows for continued advanced research in this area, which will be critical as we enter the 21st century.

Pacific Impact Exercise Test

This technology was demonstrated in the January 1999 Marine Corps Pacific Impact Exercise. This Maritime Preposition Force (MPF) training exercise called for 550 Principal End Items (PEI) (mostly rolling stock) to be moved from Marine Corps Base Hawaii, Kaneohe Bay and staged at Hotel Pier, Pearl Harbor. From there, gear was loaded and shipped to the Big Island, offloaded at the Kawaihae pier, segregated by the end user, and convoyed to the Pohakuloa Training Area (PTA). All items were tagged with radio frequency identification tags and programmed with appropriate inform ation at Kaneohe Bay. The data was read during embarkation, debarkation and at the final destination. Enroute to the PTA, the convoy was tracked via satellite, thus providing in-transit visibility The RF tagging equipment was associated to Marine Corps assets by taking advantage of a relational database capability. Information from existing Marine Corps legacy systems produced a Unit Deployment List (UDL), which served as a thorough descriptor of tagged assets. Data dissemination was provided via an intuitive web-based interface that provided access to required logistics data from the intranet server or the internet. End users could locate specific PEIs based on UDL descriptors, view PEIs based on location and view statistical graphs on offload status. The test accomplished its objective of demonstrating that Radio Frequency Identification technologies can provide real time, seamless asset visibility under a realistic MPF offload scenario. This project is an example of successful Department of the Navy teaming of the Marine Corps, ONR Science & Technology, Naval Science Assistance Program (NSAP), NFESC, and private industry.

Figure 2:
Existing method of asset tracking. Barcode scanned by hand with handwritten backup.

Point of Departure

The term asset visibility covers a broad spectrum of problem areas and possible applications. As NFESC's work has progressed, new requirements and priorities continue to emerge. One of those requirements is the need for precision asset location in a shipboard environment. Fast paced technology development continues to provide solutions to problems that were once thought impossible to solve. The possibility exists to demonstrate a solution to the precision asset location problem by examining both RFID and Ultra Wideband (UWB) technology. State of the art systems using RFID technology can provide local area visibility of equipment and supplies in near real time or on an as-needed basis; however, they suffer from three technological disadvantages: 1) Inability to provide precision location of assets, 2) Susceptibility to multipath fading of the RF signal, and 3) Inability to transmit large amounts of data in a short time period. UWB is a technology that has been under development for many years. The physical characteristics of UWB signals allow solutions to the challenges of traditional RF transmissions to be obtained. While this technology has been around since the 50's, only recent gains in high speed digital processing has made its application practical. UWB transmissions have the ability to transmit large amounts of data in short periods of time, are less susceptible to multipath fading and are inherently configured to provide precision location. NFESC will be testing these two technologies under various conditions onboard the SS Curtis in Port Hueneme to characterize their phenomenology.

In terms of asset visibility, military commanders need to be able to identify an asset, determine where it is, and finally determine any problems with it. this means determine the asset's status/condition as well as its identification and location. Previous work at NFESC has led to the development of a cargo health monitoring capability employing remote sensors and wireless communications links. This capability allows commanders to not only determine the location and identification of an asset, but also the physical environment which it has been exposed to during throughput.

Conclusion

The test at the PTA showed us that total asset visibility was achievable using RFID technologies. We achieved the four levels of asset visibility by using RFID tags, fixed interrogators, hand held interrogators, satellite messaging, and intuitive web-based interface. Although the technologies were a great success, the test was performed in a limited environment under somewhat controlled conditions. There is still a great deal of work ahead to ensure that a robust system can be deployed throughout the Naval Forces.

As we move into the 21st century, a new way of doing business using RFID technologies will be the standard. With the decreasing cost and size of microelectronics, it is possible to envision that a chip can be embedded in every item that we manage. As industry heads in this direction, the Military must keep pace to manage assets more efficiently by reducing costs, labor and time. There will be difficult challenges ahead. However, with dedicated, coordinated and concerted effort from the DOD centers of expertise and industry, the problems can be solved.❖

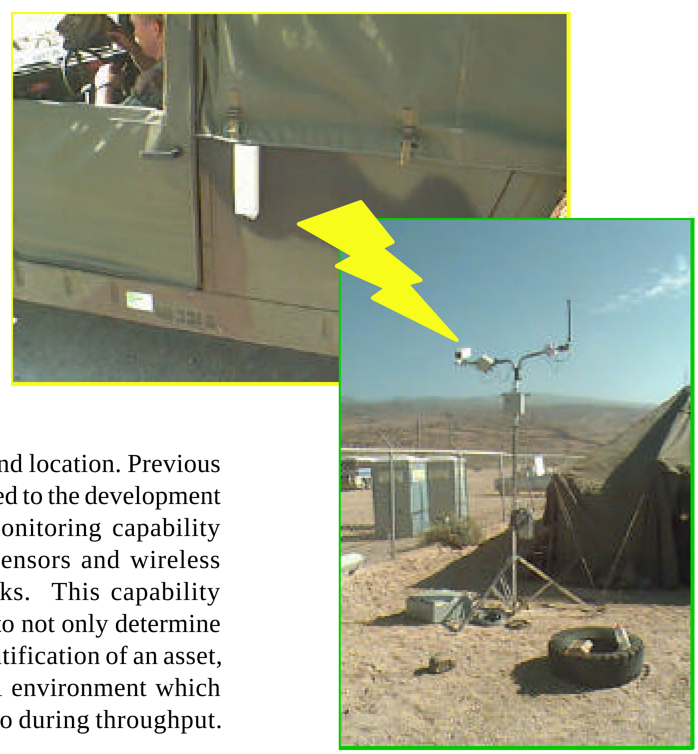


Figure 3:
New method of asset tracking. RF tag on vehicle answers query, all identifying information relayed to database server in less than 2 seconds.

Alternative Power Sources

Tandy Dilworth, Ball Aerospace
Tim Quakenbush, Ball Aerospace
Dr. Bob Nowack, Defense Advanced Research Projects Agency
Charlie Kiers, Defense Advanced Research Projects Agency

In a DARPA[1] sponsored activity, Ball supported the 1st Marines S-6/I-MEF during 1999 through three field demonstrations, including a test exercise and two Combined Arms Exercises (CAX) at Twentynine Palms, Calif. The test exercise was a retransmission site test in preparation for CAX1 and CAX2. The fuel cell team was comprised of a member from Army CECOM[2], Kris Gardner, and two members from Ball Aerospace, Rich Reinker and Tim Quakenbush. This team supported the exercises and provided the hardware, setup and training for the Marines on the fuel cell systems. The team worked jointly with Maj. Dudley Griggs, Ssgt. Adrian Muzzall, Cpl. Shane Clark and Cpl. Garcia of the 1st Marines S-6 to set up the retransmission site using five retransmission nets on Bearmat Hill. Cpl. Clark and Cpl. Garcia assembled and operated all parts of the system with direction from members of the fuel cell team.

The fuel cells and all equipment were mounted in a Humvee[3] for transport to the retransmission site location. CECOM supplied their PPS-100 fuel cell system and DARPA/ARO[4] supplied two PPS-50 fuel cell systems for use. The PPS-100 can provide 100 W of power nominally with a peak power of about 130 W. This fuel cell is lightweight and rugged, weighing only 8.3 lb without the fuel source (add an additional 4 lb for the tank and 1 lb for the valving and fuel line). The PPS-50 systems are nominal 50 W power systems capable of up to 65 W of peak power. They too are compact and lightweight, weighing only 6.5 lb without the fuel source.

In addition, Ball arranged delivery of the hydrogen fuel source standard k bottles that were used at Twentynine Palms. Ball's custom hydrogen manifold fuel delivery and electrical control system was used to connect and operate the fuel sources. The power distribution system supplied 12 V to each of the radios and allowed for uninterruptable operation by automatically switching to the second hydrogen bottle when the first became empty. Maj. Griggs stated that after seeing two field demonstrations, he was comfortable with helo-lifting a fuel cell powered retransmission site without a backup generator.

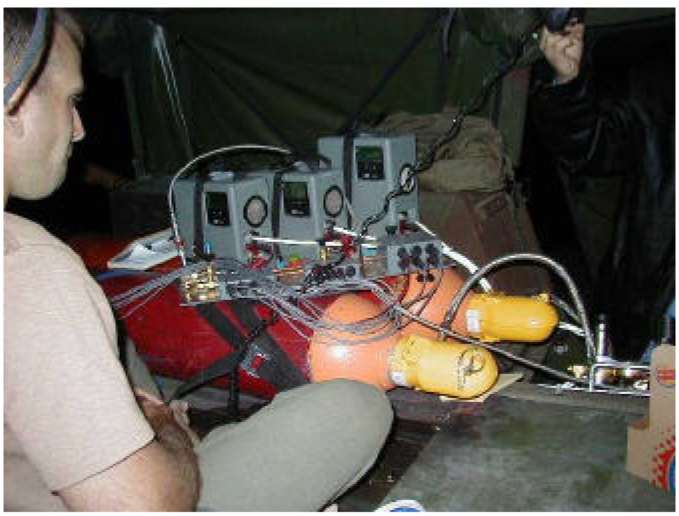
The first field test demonstrated to the Marine Corps that small fuel cells are a reliable, lightweight and cost-effective means of providing power for military applications. The fuel cells performed extremely well during the retransmission site test, operating for over 25 continuous hours.

PPS-100 (100-watt portable power fuel cell system)

PPS-50 (50-watt portable power fuel cell system)

1 Defense Advanced Research Projects Agency
2 Communications and Electronics Command – sponsor of the PPS-100
3 High-mobility multi-purpose wheeled vehicle, used by military.
4 Army Research Office

Fuel cell power supplies strapped to a frame with the fuel supply tubing and power distribution connectors. The pair of PPS-50 supplies is left and center and the PPS-100 is on the right. The fuel supply flex hose enters the photograph from the upper left, and the potable water exhaust tubing exits at the lower left.



The fuel cell power systems inside of the Humvee with Cpl. Clark.

Fuel cell setup in the back of the Humvee

Ball also supported CAX 1-00 and CAX 2-00 held in October and November respectively. The setup for the two exercises remained virtually unchanged from the test exercise configuration.

During the first CAX activity, the fuel cells were required for two different applications. The first application was to power a retransmission site at a location where any system problems could be mitigated. The Marines chose a site to support communications in the Quackenbush corridor that was accessible with a Humvee. The second application during CAX1 was structured to fully load all three fuel cell systems. Both events were operated from the Humvee.

The fuel cell systems powered nine PRC-119 radios (system capacity is 12 radios simultaneously) and a laptop computer from 18 Oct through 19 Oct for 20 hours with no glitches in power. One PPS-50 was loaded with the two busiest nets (four radios) to test heavy communications traffic conditions. The remaining five radios were attached to the PPS-100 and the computer was powered by the remaining PPS-50. Ball's portable power fuel cell systems are designed to be load following and respond to the power demand instantaneously using a custom software control algorithm. The fuel cell systems tracked changes in power demand fast enough to avoid any brownout conditions for the radios. Two idling nets draw 25 W, one idle net and one transmitting net draw 40 W, and both nets transmitting draw 55 W. The entire retransmission site system used 30 W when idle and 130 W when transmitting.

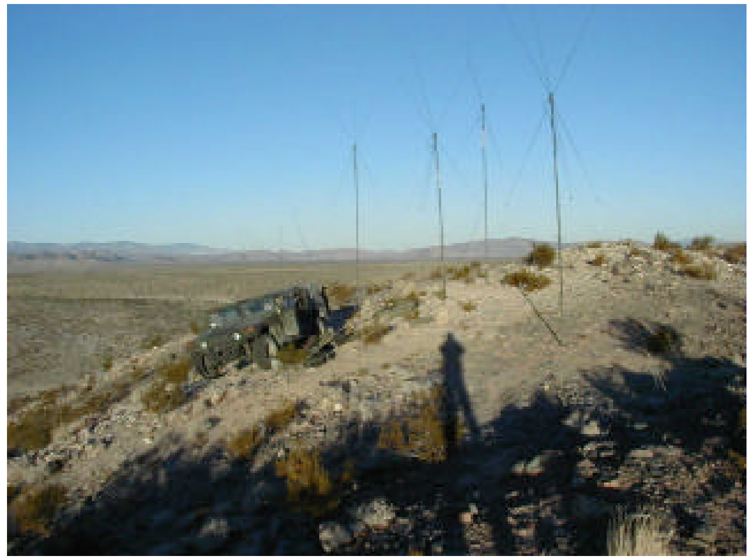
The training that the Marines received during the test exercise and the CAX 1-00 allowed them to setup, operate, and assess the fuel cell power system and fuel source during CAX 2-00 without any assistance from Ball or CECOM. This was due to the capability of the Marines operating the system and the ease of operation of the fuel cell power system and its associated hydrogen system.

The final CAX of 1999, CAX 2-00, also produced positive results. Setup was accomplished in good time and the PRC-119 radios were operating properly. During the second exercise, one PPS-50 shut down due to a stack temperature failure. The portable power systems are designed to protect themselves from permanent failure by shutting off the load for some out-of-specification conditions and aborting in others. The PPS unit that shut down is currently being evaluated by Ball to determine the exact cause of the problem. Maj. Griggs stated that "the impact of the downed PPS-50 on the retransmission site was small. They [the Marines operating the network] had redundancy to cover a much greater outage and were able to restore the working capability based upon brief training with you [Ball] and kept the six nets up throughout." Maj. Grigg's final report to the military showed that use of the fuel cell power systems rather than batteries resulted in a savings of $8,000 for one CAX operation alone.

Fuel Cells Summary

The total capacity of the fuel cell power systems used in the three exercises was 200 W nominal and 260 W peak or burst power. The test exercises did not truly stretch the limits of these systems using only 130 W of the total capacity at peak transmission. However, CAX 1-00 did demonstrate the suitability of the fuel cell system for load cycling operations and the practicality of using hydrogen. While the radio network was idle or inactive, only 25 W of power was required, which could have been supplied by only one PPS-50.

At 100% duty cycle for one of the PPS-50 units, 55 W were required, which resulted from both nets transmitting simultaneously. The fuel cell power systems are able to respond in real-time to the load. The highest or peak load was planned to occur during the second application where the portable power systems were used to power a pre-amplifier system. When all nets and the Humvee radio are retransmitting, there is a combined power demand of 240 W on the three fuel cell power systems.

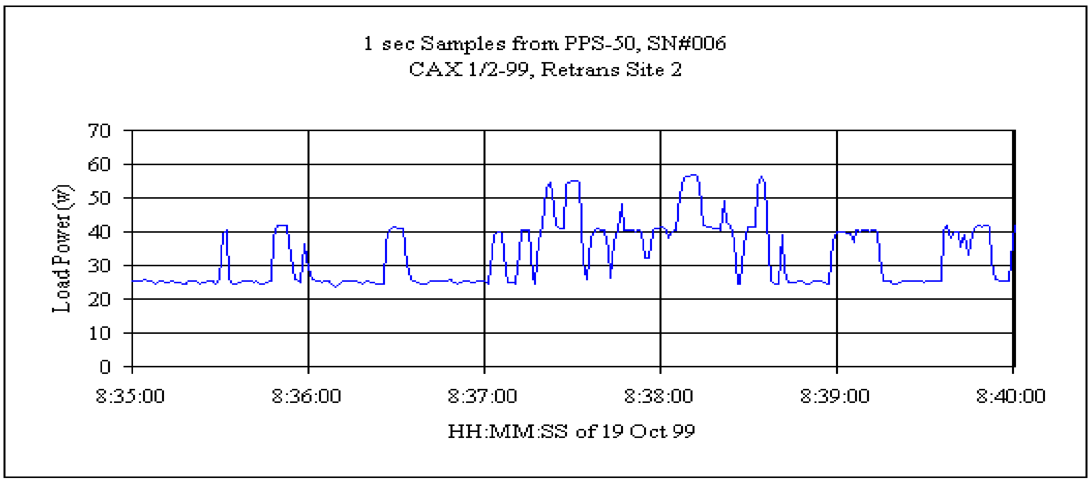


The hilltop site for retrans 2. The distant hill behind the antennas is OP Creole. The radios and fuel cell systems are in the Humvee.

Hydrogen Usage and Operating Costs

The hydrogen usage and operating costs for the retransmission site demonstration and the two combined arms exercise activities was enlightening. The tables demonstrate that operating fuel cells is a cost-effective and efficient means of providing power.

The most significant data in the table are the total running time, total power, the amount of fuel used, and the total cost for each of the activities. Comparing the total power output by the fuel cells with the equivalent in battery provided power means that for an energy requirement of 15,353 Whr, 103 BA5590 batteries would have been required. These 103 batteries would cost $7,725 as compared to the total operating cost of $245.50 for the fuel cell power systems. After the initial fuel cell purchase, operating costs are less than 5% of the costs to operate BA5590 batteries (assuming the cost of a BA5590 battery is $75 / battery and provides 150 Whr of energy). On a per day basis, the table at the bottom of this page illustrates the cost comparison.



One-second samples of load power logged from PPS-50, SN#006. Two nets were attached to this supply. The low values of 25 W occur when both nets are idle. The 40 W power draw occurs when one of the nets is retransmitting and the 55 W power draw occurs when both nets are retransmitting.

Maj. Griggs stated that a typical retransmission site uses 12 to 20 radios and each radio uses about one BA5590 per day of operation. The table at the top of the page 4 compares fuel cells and BA5590s to operate a 12-radio retransmit site with PRC-119 radios.

Maj. Griggs, SSgt. Muzzall, Cpl. Clark and Cpl. Garcia said the system exceeded all expectations. There was initially some concern about working around the hydrogen bottles. It was a new type of fuel and the 1st Marines S-6 were not familiar with the robust nature of approved steel cylinders. After the initial training and use of the fuel cell system, Cpl. Clark and Cpl. Garcia were very comfortable working with the hydrogen gas fuel. Hydrogen is a mobile gas that rises and dissipates rapidly, compared to liquid fuels such as propane, gasoline and diesel fuels that collect in low areas and dissipate more slowly.

Elements of Hydrogen Usage	Sum	Average	Units
Number of radios	---	9	
Number of power amps	---	0.25	
Number of notebook computers	---	0.25	
Running time	182.5	---	hr
Total energy produced	15353	---	Whr
Mean power to electrical loads	---	92.26244875	W
H_2 used	455.7	---	ft3
Energy produced / fuel used	---	37.94814273	Whr / ft3
Actual K bottles used	2.5535	---	
Activated carbon filters used	1	---	

Special acknowledgements and thank you to Charlie Kiers and Jim Broyles for helping to arrange Ball's participation at these exercises, and to the 1st Marines, especially to Col. Paxton, Maj. Griggs, Cpl. Garcia and Cpl. Clark. Also, thanks to OST, ARL, SOCOM, DARPA, Army CECOM, ARO and I-MEF. The PPS fuel cell power systems are near their present state of development because of the dedicated support of these groups. ❖

Actual Operating Fuel Costs	**Each**	**Subtotal**	**Units**
No. of bottles	5		
No. of days bottles in field	49		
Bottle delivery and pickup	$4.00	$4.00	per trip
Fuel cost	$20.50	$102.50	per bottle
Bottle rental	$0.20	$49.00	per bottle-day
Activated carbon filter	$90.00	$90.00	
Sales tax		$11.74	
Total Cost		**$245.50**	
Total energy produced		15353	Whr
Cost per energy		$0.0160	$/Whr

Fuel Cell Cost per day of Operation		**BA5590 Cost per day of Operation**	
6 transmitting radios = 8 amps at 12 V (measured) 6 receiving radios = 3.5 amps at 12 V (measured) Energy used per day by 6 retransmit nets = 3.3 kWh per day			
Industrial grade H_2 gas ($20 / k bottle)	$7.50	12 BA5590 batteries per day ($75 each)	$900
k bottle rental ($6/month)	$0.20		
k bottle delivery ($8 for 5 k bottles)	$1.60		
Activated carbon H_2 filter ($45/ k bottle)	$16.88		
Total Cost per day	**$26.18**	**Total Cost per day**	**$900**

Gliders For The Fleet

LtCol John James, Aviation Budget Officer, MARFORPAC

Gliders for the fleet!!! A proposal with unlimited courses of action has drawn both praise and ridicule from aviators across the Marine Corps. In a service touting quantum technological advances in warfighting with the MV-22, 4BN/4BW and Joint Strike Fighter, why would the Marines be interested in an apparent retrograde step?

For economy of flight...

James Carville might suggest, it's the economy (gentlemen)." Early Bird articles and presidential debates harp on military readiness and the call for increases in Defense budgeting. With proposals for increases over the next ten years of $45 billion by Mr. Bush and $100 billion by Mr. Gore, neither matches the figures described in studies by the CBO (*Budgeting for Defense: Maintaining Today's Forces*) or CSIS (*Averting the Defense Train Wreck in the New Millennium*). These studies, respectively requiring 3.5% and 3.9% of the GDP to sustain the QDR 97 force, in turn, fall short of the Commandant's desires for four percent.

Meanwhile Harrier pilots, who fly the most aeronautically sophisticated aircraft in the inventory, are budgeted to fly hours considered "minimums" by any other community. Despite the Marine Aviation Campaign Plan's meticulous scrub of sorties, the Navy Comptroller has dramatically under-funded the FY01 Flight Hour Program. For MARFORPAC alone, the delta exceeds $100 million in a $500 million budget. Aviators are starving for flight time. Operational sorties, already sparse, may be threatened to extinction.

If a glider could help, the economic advantages would be compelling. A look at the MARFORPAC model will explain why. The three categories of Aviation dollars are Aviation Depot Level Repairables (AVDLR) – the big ticket parts of engines, transmissions and other dynamic components, Aviation Fleet Maintenance (AFM), also known as consumables, and fuel. CNO's N88 just added a fourth category for contracts in FY01. Activity groups distinguish dollars for Fleet Replacement Squadrons (FRS) from those of TACAIR, Staff and Fleet Air Stations (FAS).

To give an idea of the proportionate shares of these dollar requirements, here are the figures for MARFORPAC in FY01. AVDLR and AFM comprise about 83% of the total; fuel is another 15%. Without engines or transmissions, gliders eliminate nearly all of the AVDLR and AFM cost. The only fuel consumed is that for the tow plane. If contracted, the going commercial rate is $25 to $50 a sortie. In an over-simplification, if the Marine Corps flew just 1% of its hours in gliders, it would save $5 million. Conversely, if the Marine Corps determined *any* utility in augmenting aircrew hours, or even in flying non-aircrew in gliders, the additional costs would be negligible.

For tactical posterity...

Although the financial argument is hard to question, the lessons of history provide a mixed review of gliders in tactical application. World War II offers some of the best examples. And they exude the principles of War.

Belgium's Eben Emael was an "impregnable" fortress, strategically located to stop the advance of the German Army. Through extensive study, the Germans determined the fort vulnerable to a surprise airborne assault. If they could mass troops on top of the fortress they could maneuver down through the hatches and tunnels unencumbered by crossfire. So at first light, 5 May 1940, Junker Ju-52 transports towed 42 DFS-230 gliders to 10,000 feet, each carrying seven to eight paratroopers. With an ingress speed of 100 knots, secure from the onslaught of any artillery barrage, 10 of these gliders used parachutes and retro-rockets to arrest their rooftop landing. They delivered 78 troops to secure the objective from the top down. The Germans also used gliders to insert troops behind Russian lines in October of 1941.

The Americans and British used Gliders in the offensive on Sicily, 10 July 1943. The weather was less than marginal. Of the 137 British Gliders released, 69 came down in the sea drowning 200 of the passengers and crew; 56 landed in the wrong part of Sicily; and only 12 reached the target area, a bridge south of Syracuse. Just the same, with 2,781 paratroopers

MARFORPAC FY01 FLIGHT HOUR BUDGET

	TACAIR	*Staff*	*FRS*	*FAS*	*Total*
Fuel	58.675	1.37	15.783	1.579	77.407
AVDLR	249.605	3.907	28.489	2.607	284.608
AFM	138.472	2.547	15.923	1.503	156.942
Contracts	5.571		0.55	5.457	11.578
Total	452.323	7.824	60.745	11.146	532.038

scattered over a 50-mile radius, the airborne chaos deceived the defenders into thinking the invasion was of much grander scale. Consequently, reserves were withheld from the beaches unwittingly enabling a successful landing.

Operation Overlord, the invasion of Normandy 6 June 1944, began shortly after midnight as the British 6th Airborne Division landed in gliders to seize the Benouville canal-bridge, north of Caen. It was the advance guard followed by 23,400 British Red Berets and American Airborne Divisions who landed behind Utah beach by parachute and glider. Again scattered by high winds, the dispersed forces swarmed the countryside to attack on opportunity without much unity of command. They captured the German 91st Division Commander denying his economy-of-force division from defending at Utah Beach.

When the United Sates decided gliders offered valuable tactical and logistical versatility, they built 12,000 Waco CG-4A gliders carrying 15 fully equipped troops each, or an equivalent load of cargo. The CG-4A's were used in the Sicily invasion alongside the British Horsa with a 29troop capacity. Where larger was better, the British used the 17,500lb payload Hamilcar. But the gargantuan glider of the war was the German ME-321 Gigant, aptly named, with a heavy weapons payload of 48,500lbs or 130 troops. It was towed by up to three Messerschmitt ME-110's.

Gliders were also used in Vietnam for reconnaissance purposes because of their stealth and simplicity. With no acoustic signature they were difficult to detect; no thermal signature, secure from heat-seeking SAMS. Add to any of these glider variants the night vision and GPS technology of today and these disposable transports might offer solutions to SOLIC scenarios worldwide.

For training proliferation…

Although their tactical exploits may now be history, gliders are presently flown at the Air Force Academy to train Cadets, and at the Navy Test Pilot School (NTPS) in Patuxent River Maryland to train Navy and Marine Corps Test Pilots. The seven-sortie Navy syllabus includes familiarization, aerobatics, emergency procedures and two solo flights.

Glider instructors contend there are aeronautical sensitivities, heightened by gliding, which are never acquired in powered flight. The situational awareness of altitude, airspeed and wind-direction is a basic aeronautical skill, which takes on new meaning in glider flight. In the cockpit, there may be three Vertical Speed Indicators–instantaneous, knots and feet per minute. The knots allow mental verification of time-distance capabilities. Accordingly, glider pilots on Oahu know when they can glide to Molokai and back. The mantra of energy management is "be ever fast, high and upwind."

TACAIR Cost per Hr	
AV-8B	$6,237
CH-46E	$2,728
CH-53D	$5,105
CH-53E	$5,952
KC-130F	$2,585
KC-130R	$2,732
AH-1W	$2,551
UH-1N	$1,832
F-18C	$4,131
F-18D	$4,363

Sampling a T&R Manual for sorties in TACAIR, Staff, FRS, or FAS will yield opportunities to augment, or just to choreograph many of the training sorties. Aerobatics, form, tacform, terrain flying, are examples.

As an unpowered platform, the two-seat glider offers an opportunity to train special skills at a small fraction of the cost of any other platform. Compare $25 a sortie to the CH-53E now budgeted at nearly $6,000 an hour. Configured with FLIR for example, the glider could provide hundreds of system training hours for the cost of a single hour in the CH-53. Configuring a "tally rack" on each wing to carry MK-76's would add a mere 100lbs to the payload. Tactical Air Control Party (TACP) training would open up to a wider audience. That an O311 grunt could make NCO without ever participating in an air assault could be a thing of the past. Ground Air Integrated Training would be unprecedented.

There are some limitations to gliding, (beyond the obvious). FAA regulations preclude soaring or gliding at night. In the absence of sunlight, much of the orographic lift dissipates leaving unpowered flight to the fate of gravity. If NVG operations were considered, they might be restricted to a Military Operating Area with special permission; or they may revive the pin-hole type used in daylight hours. Parameters imposed for safety, like "no aerobatics below1500 feet, no spins below 2500feet, no soaring below 1000 feet" are written in blood. The few mishaps experienced at NTPS have all been prevented since by standardization.

Still the capabilities are yet to be fully explored. The world's records include altitudes of nearly 15,000 meters, airspeeds of 217kph over a 100km course, and free distances with a minimum claim over 1400km. Orographic wind currents along extended ridgelines, called waves, have been known to lift gliders at rates beyond 2500 fpm. Try that for your next Oscar pattern.

Although no glider program exists for the fleet, the training is not hard to come by. On Oahu for example, Dillingham airfield has two commercial outfits and the Civil Air Patrol. Two of the three use the same Schweizer 232 used at Patuxent River and approved by NAVAIR.

Implementation

The requirements for the glider program would be…

a. To provide positive reinforcement of aeronautical skills and to teach important aviation concepts,

b. To possess sufficient commonality to fleet aircraft in instrumentation,

c. To require procedures that are similar to those in fleet aircraft,

d. To convince the Marine Corps and Navy leadership to use gliders as training aids,

e. To count the flight hours in gliders as they would any other approved airframe, and accept the costs associated with the program.

f. In order to implement such a program the Marine Corps should assess what gliders could contribute to T&R by T/M/S and contract the modification of an off-the-shelf glider for required instrumentation and equipment. With safety of flight certification, and center of gravity and weight and balance documentation, the project may best be suited to Patuxent River or HMX.

The substance of the Marine Corps is in its innovation. Reputed for so long, for doing so much with so little, we are soon to assume perhaps a different role as the forerunners of high tech warfare. As we extol the virtues of LCAC's, AAAV's, light 155mm howitzers and field expedient digital video teleconferencing, we still deal with fundamental issues like retention, job satisfaction, quality of life, espirit de corps and tactical proficiency. There is a niche for gliders in doing more with less. And if there remains any doubt, take a ride. It will make you smile. ❖

Force Warfighting Lab

Future Topics:

Predictive Readiness
Flexible Communications Manager
High Speed Lighterage

Point of Contact:

Shujie Chang, P.E.
Science Advisor
Marine Forces Pacific

MARFORPAC
Box 64105 (Attn: SciAd)
Camp Smith, HI 96861-4105

Email: Changs@mfp.usmc.mil
Bus: 808-477-8577
DSN: 315-477-8577
Fax: 801-912-6396